DOCUMENT PREPARATION SYSTEMS
J. Nievergelt, G. Coray, J.D. Nicoud, A.C. Shaw (eds.)
© North-Holland Publishing Company, 1982

Document Preparation Systems and Commercial Typesetting

John W. Seybold
Seybold Publications, Inc., Box 644, Media, PA 19063

Abstract. *The setting for the development of methods of photocomposition is described, along with the various "generations" of such equipment. The history of the use of computer programs for the production of typeset output is traced. Hardware/software systems for inputting, editing and formatting text materials are considered, along with the implications of such systems with respect to their editorial and production environments. Similarities and differences between "commercial" applications and "document preparation systems" are also considered.*

1. Introduction

Computer applications for document processing, on the one hand, and for commercial typesetting, on the other, have, on the whole, represented two different and unrelated approaches to text processing. They have evolved from different needs and each has followed its own course. Yet it may well be that, in the new era of microcomputer technology, their paths are converging. Nevertheless, despite their disparate antecedents there is a certain commonality of approach, and there are obviously ways to bridge the gaps between the two disciplines. Moreover, each has something to learn from the other.

For example, in the commercial typesetting area some of the batch input and editing techniques will be found to be quite comparable to those which have evolved to deal with problems of documentation. In the field of document processing, interactive editing capabilities which have long been applied in the publishing industry—especially in newspapers—are now more common.

In the matter of pagination, problems and solutions will also be found to be quite similar in nature.

The bridge between the two disciplines has developed not only out of the similarity of tasks which each is required to perform, but also because those who are users of document preparation systems sometimes wish, and often need, to present their final output in the form of typeset pages, finding it necessary to develop programs to "drive" typesetters or to convert their files into a form in which they can be processed through commercial typesetting hardware and software systems.

2. The Evolution of Commercial Systems

In this article the term "commercial typesetting" will take on a broader meaning than is customarily attached to it. In the publishing industry, "commercial" typesetting is one of three major categories of activity in which typesetting (or "composition") take place. One is the newsaper industry. A second is the "in-plant" market. The third is "commercial" or trade typesetting. In the first two classifications, typesetting is an internal byproduct of writing, editing and publishing. In the third case it is a service business with respect to which writing, editing and publishing activities have traditionally been carried forward very much at arm's length.

However, in the context of this analysis we shall use the term "commercial typesetting" to describe the activities involved in typesetting and otherwise preparing for publication a product of a certain kind, whether these activities are undertaken for profit, in a "trade" sense, or are carried forward "in-house" to service the needs of writers and editors engaged either by publishers or by others for whom "publishing" is a secondary requirement in the support of a product or activity, as is the case with documentation.

Thus, in the sense which is relevant for this paper, "commercial typesetting" has more to do with the appearance of the product (its aesthetic properties) and the processing steps necessary to achieve this result, than with the question of whether or not the activity is performed by traditional (or even "new era") tradespeople.

Typesetting as it once was. For the purposes of this examination it seems hardly necessary to trace the beginnings of typesetting from the fourteenth-century origins of "movable type," attributed especially to Johan Gutenberg. That the western world experienced a cultural revolution as a result of the impact of the typesetting and printing technology set into motion at that time can hardly be doubted, although it may be as useful to assert that the technology came into being because the ferment of the times demanded it. But for the frame of reference pertinent to this particular study we need go no further back than the first half of the twentieth century. What has happened since then—in the areas of printing and reprographics generally, of computer hardware and software, and of imaging (or "typesetting") technology—is what we are now concerned with.

Although some "hand composition" (à la Gutenberg) still takes place, the vast bulk of the typesetting activity which occurred in the first half of the twentieth century was performed by one of two methods: linotype (or "slugcasting") and Monotype. Both of these processes were invented toward the end of the nineteenth century. Ottmar Mergenthaler developed the first practical "circulating matrix" machine, whereby a keyboard operator caused brass molds or matrices to be transported to an "assembler", with "spacebands" separating individual words. The keyboard operator made "end-of-line" decisions so that the width of the assembled characters would be less than the intended "measure" or line length by an amount that could be compensated for by virtue of the expansion of wedge-shaped spacebands, pressed upward by a lever until the line of characters occupies the desired space and can be cast as a "slug." This slug, created from molten metal, was then positioned with many others into a frame which represented a page or a "form" of (for example) two, four or eight pages, and locked up to be mounted on a letterpress printing press. For longer runs impressions could be taken from the pages of raised type and electrotype or stereotype printing plates were cast.

The alternative typesetting process, developed by Tolbert Lanston, was "Monotype." Here an operator at a keyboard perforated a wide paper ribbon. Each character that he called for was identified by a combination of holes in this ribbon, and the width of the character, determined by its location on the casting matrix to be mounted in the machine, was "known" to the keyboard by a particular mechanical layout for the font in question and signalled to the operator by the mechanical movement of a revolving counter. Thus the operator could make the appropriate end-of-line decision and at the end of each line he would key in the value which the counter informed him represented the amount by which the line was "short" of its required length. The tape was then read by a Monotype casting machine, starting at the end of the job so that for each line the necessary

justification statistics would be known by the machine in order that it could position certain wedges in such fashion that interword spaces cast would be of the required width to cause the line to justify.

With Monotype, each character or space was cast from hot lead separately, and deposited in a tray so that the output could be carefully removed and positioned for lock-up in the same manner as if the characters had been cast as slugs.

The Monotype approach generally yielded more attractive results because, despite the need to design characters to a common system of measurement (18 units to the printer's em), the type face designer could assign to individual characters whatever width values he chose. The matrix which held these character molds permitted a "font" to consist (most commonly) of 225 positions. Each character of the text type face ("roman") could be different in width from that of the "italic," and "small caps" could also be used. With linotype, on the other hand, it was common for italic characters to occupy the same brass matrix as the roman font (and hence assume their widths), with the operator setting a "rail" to indicate which of the two images should be included in the slug. This requirement compromised the design of the italic characters and represented only one of the respects in which the appearance of type cast from linotype was considered inferior to that created by the Monotype method.

Despite the aesthetic superiority of Monotype, linotype was the more economical process, and it prevailed for newspaper setting. Gradually, especially in the United States, linotype became the predominant device for the setting of even so-called "quality" book work, as more attention was directed by vendors of linotype machines to the design of improved book faces.

Note that these two techniques were particularly congenial for printing by letterpress. They both resulted in a raised mirror image of type characters, capable of transferring ink from roller to paper, and capable of withstanding sufficient pressure to avoid wear during a good many thousands of printing impressions.

Both techniques avoided the need to "distribute" types after printing since, unlike hand composition, they could be thrown into the melting pot in order to salvage for reuse the lead and other metals from which they were cast. Therefore new work was always composed from new or recycled metal.

Aside from "hot type" and some handsetting with "foundry" types, what else was available for composition? Only the photographing of characters drawn by pen, or the carving or etching of characters into wood or metal blocks—excepting, of course, the possibility of printing by means of mimeograph or hectograph ("ditto"). Here the typewriter could be used (ornamented by handwork on stencil or "master"). The quality of either mimeograph or ditto left much to be desired and only a relatively small run—perhaps several hundred copies—could be obtained from a stencil or paper ditto master. It was also not possible to produce "signatures" from forms or four, eight, sixteen, 32 or 64 pages since these "office duplicators" generally could handle nothing much larger than 8½ × 11 or A-4-sized pages. The collation and binding of the product was therefore also inferior.

But beginning in the late 1930s, and especially after World War II, the lithographic printing process became more and more popular, with improved presses and greater attention to quality control. This process, in its "offset lithography" form, gradually improved to the point where it was virtually indistinguishable by the layman from letterpress, and where relatively long press runs (of several hundred thousand) were possible.

The offset process, as it is generally known in the U.S. ("litho" overseas), does not require the use of raised type. (For that matter, neither does gravure). Hot metal typesetting thus became somewhat of a liability since it was necessary to produce "repro proofs" and photograph these in order to obtain the negatives or positives from which litho plates are made. Whether a liability or not, setting in metal was no longer a necessity, and the lithographic process was certainly more appropriate for the inexpensive reproduction of illustrations, avoiding costly and time-consuming photoengraving processes.

Strike-on techniques. The time was ripe, therefore, for an alternative typesetting technology, photographic in nature. Some "strike-on" typesetting also was introduced, with modifications in the typewriter to permit the use of more attractive proportional type characters, although to "justify" such composition was exceedingly difficult until the IBM "Composer," based upon the magnetic-tape selectric typewriter, came into being in the 1960s. The development of improved electrographic office copiers in the 1950s and 1960s also stimulated the use of "strike-on" techniques for short runs of small documents, as a much more desireable substitute for "ditto" and mimeographic reproduction, and in the meantime the use of paper printing plates for small offset ("multigraphic" or "duplicator") presses permitted the use of strike-on for internal memoranda and documentation where aesthetic considerations were not compelling and the economics of the cheaper process overcame the lack of economy in the use of paper as well as the inability to achieve "information compression" when the type images were monospaced rather than proportional.

In the latter connection, it is readily evident that "true printers' type"—or characters so designed—make for documents that are more readable, more understandable because of the available of a larger character repertoire of symbols and faces, and more compact or "compressed" in terms of numbers of words per page.

The phototypesetter. Efforts to design a photographic typesetter began to bear fruit as early as the late 1940s and in the 1950s several such machines were introduced. The first two were based upon the principles of linotype and Monotype, respectively, and were known as "first-generation" devices. Shortly thereafter, "second-generation" phototypesetters were offered and gained some acceptance. These did not imitate the (inappropriate) technology of the hot metal machines but were designed from new beginnings. Soon a wide range of choices came into being, at various price levels, offering trade-offs in cost, quality of output, speed, and flexibility. Then in the late 1960s and early 1970s, "third generation" high-speed cathode ray tube typesetting machines ("CRT typesetters") entered the marketplace, first at prices in hundreds of thousands of dollars, and even before 1980 at prices from $50,000 to $120,000.

"Fourth generation" machines, using a laser to perform the task of character generation and photographic exposure, also put in their appearance in the late 1970's and early 1980's.

For the most part, phototypesetters expose images onto photographic paper or film. The development of these photo-sensitive materials requires the use of a processor and dryer and this fact may have inhibited acceptance of the technology in the office environment. "Dry" photo processes, using a "dry silver" emulsion, have so far not been widely accepted, but more recently electrographic typesetting devices have been introduced.

Here the office copier "engine," or something comparable forms characters by means of electrostatic or magnetic charges on a silenium (or similar) drum or belt, and transfers "toner" (wet or dry) onto paper. Such an engine can be used in order to create "camera ready" copy, which would be photographed for platemaking in the same manner as if it had been exposed onto light-sensitive materials, or—with some sacrifice in quality—it could be employed for multi-copy (reprographic) purposes.

By the early 1980's, hot metal machines no longer represented the prevailing method of setting type. Although still viable or even necessary in a few applications, and still persisting in out-of-the-way locations, the common method of setting type today is photographic, even if letterpress printing is still employed. (New letterpress platemaking techniques have been invented which permit the creation of raised images from light-sensitive materials.) In fact, the prediction today is that for some applications, before many years have passed, type images will be formed directly upon the surfaces of printing plates so that even "phototypesetters" will not be needed. And it is predicted, as well, that many printed products will be created on demand by reprographic engines driven by digital impulses, in such fashion that each book, leaflet or brochure will or could be produced serially, in its entirety, before another copy is even "typeset."

3. Functions of the Typesetting Device

The earliest phototypesetters were electro-mechanical devices. With the passage of time more components have become electronic in nature, and fewer are mechanical. Hence prices of such offerings have been reduced dramatically despite the inflationary spiral all around us. Reliability has been significantly improved as well.

Three aspects of typesetting machines deserve particular attention. One is character selection. From a grid, matrix, disk or drum of photographic masters, characters must be selected one at a time for exposure. Over the years the mechanical masking out of unwanted characters has given way to exposure by selective "flashing" of rotating master images, and now, with third or fourth-generation machines, by painting characters or entire lines of type through the technique of generating strokes or raster dots on a CRT tube or directly upon paper.

Sizing of images was accomplished by the interposition of scaling lenses. Now sizing is frequently accomplished by changing stroking or matrix patterns through electronics.

Character positioning (escapement or laydown) was initially performed by moving the film plane across the exposure area or by stepping the image-carrying light beam with mirror or prism. These techniques still exist, but increasingly the entire page area, up to the full width of a broadsheet newspaper, is exposed by deflecting a cathode ray electron beam or laser light source, with appropriate electronic or optical corrections to deal with problems of image distortion.

The relation to text formatting. Since electronics were now used so extensively to control the character-generating features of the typesetter it was only natural to consider the application of electronics to deal with the formatting of the text to be typeset, and even

perhaps to use the same electronic system to perform both functions. But this did not happen in the first instance, and it is unlikely that in the long run a sharing of such electronic tasks will be considered advisable.

4. Driving the New Typesetters

The first phototypesetting machines were not driven by computers. Computers had not yet been removed from the scientific and military environments where they were first applied. Instead, these devices were activated and controlled by complex electrical switching relays. For the first generation machines input was created in precisely the same manner as was the case for hot metal. Thus the Intertype Fotosetter was a "direct input device" which looked exactly like a linecaster keyboard. The Monophoto keyboard was precisely the same as for Monotype. The first applications of computer technology were, moreover, applied to the automation of hot metal linecasting, rather than to the driving of phototypesetters. In order to pick up this strand of the narrative it is necessary to explain that a technique was developed in the early 1930s to activate hot metal linecasters from perforated paper tape. These were "teletypesetting" keyboards—a typewriter-like device with a paper tape punch attached, and a tray which contained a comb-like arrangement of metal plates from which character width information could be derived. A six-level "TTS" paper tape, containing text, line-ending decisions, and relevant codes, such as "return and elevate" to signal the end of a line, and "upper rail" to activate the alternate (bold or italic) matrix positions, was prepared by the operator and subsequently "read" by a mechanical reader attached to the linecasting machine, whose "fingers" sensed the presence or absence of holes in the tape and sent this information electrically to solenoids which actually depressed the keys and bars of the linecaster keyboard, just as if they were activated manually.

This method was not widely used, however, until after World War II. As was the case with direct input, the operator had to make his own end-of-line decisions, and he was assisted in this process by observing the juxtaposition of two pointers, one of which kept track of cumulating character width values and the other the interword space expansion potential. Linotype fonts were redesigned to a "unit" system so that width values could indeed be counted. Initially the counting process was purely mechanical, but later it became electronic.

The introduction of computers. In the early 1960s the possibility arose that TTS or other similar keyboards could be used to produce paper tape in an "idiot" mode. In other words, the operator would only have to key in the relevant text and some of the command codes (such as to effect a change to bold face), but was not obliged to make end-of-line decisions. The paper tape so perforated could then be inserted into a reader connected to a computer and a new tape would be reperforated which would include end-of-line signals. It was no longer necessary for the keyboards to retain information as to character widths. These could be stored in the computer. The task was, after all, purely one of computation: to determine when enough units had been accumulated, considering the number of interword spaces, so that the line fell within justification range. Then the "return and elevate" codes, inserted at the line endings by the computer program, would cause the linotype machine to justify the line.

This is the process known as "justification." However, to take care of those situations in which justification cannot be achieved between words, it was also necessary for the computer program to be able to determine whether or not the "straddle words" that made the line either too long or too short, could be broken (hyphenated) within justification range. In some of the earlier approaches an operator was called upon to make only these decisions. The reperforator unit would "beep" and call his attention to the word which prevented line justification by its inclusion or exclusion.

Since programmable computers were now available, algorithms were developed which (with some modest degree of accuracy) provided the necessary hyphenation points.

It may be seen that this great breakthrough contributed only one simple improvement to the typesetting process. The keyboarder or input operator, freed from the need to think about how lines were, in most instances, to be terminated, could key at a faster rate. Just as the TTS keyboard itself contributed to the volume of input since the depression of keys was no longer immediately tied to the casting of lines, so now the operator's fingers could serve merely to transfer letters from manuscript to paper tape.

Turning now, to the phototypesetting process, it was not long before direct input on keyboards attached to the typesetter was replaced by paper tape input. Initially this consisted of input perforated by teletypesetter-like devices, but naturally such keyboards had to contain "counting logic," whether stored electronically or mechanically. It was not long before it became evident that the same computer technology which could make end-of-line decisions for hot metal linecasters could do the same thing for phototypesetting devices, even though these were more complex—offering a much greater typographic versatility in terms of fonts and sizes which could be provided on line.

The correction process. One important limitation of photographic typesetting has always been that it is, in essence, a "blind" process. Once the input was fed into the computer program so that line endings and hyphenations could be determined, and the computer output (in the form of paper magnetic tape) was fed into the typesetter, the photographic film or paper removed and developed, then and only then could you see what you had created and it was clearly less than perfect. Keyboarding errors, or "literals" can never be avoided. Where strings of commands are also included such errors are even more likely. And there are also errors introduced by the composition process itself, such as faulty hyphenation. One of the advantages of conventional hot metal composition was that you could remove the very letters or line slugs that contained mistakes and replace them with others. Making such manual corrections is more difficult with photographic output since it can only be accomplished by "paste-up," and this is often impossible where errors require the resetting of entire paragraphs which will, when corrected, break or fit differently. Various approaches have been taken to alleviate these problems.

5. The Beginning of Typesetting "Systems"

It now became necessary to address more systematically the ways in which computers could be used to accept and format input intended for photographic typesetting devices. One method was for the operator to produce "hard copy" at the time of initial input, and for this hard copy to be proofread, and then to "merge" in the newly-perforated correc-

tions before the paper tape was fed into the computer. *Paper tape merging devices* were thus constructed which could search for character strings, meanwhile punching out a *clean tape* up to the point where the correction was to be made.

A second method was to read the text into the computer, store it on magnetic tape or disk, obtain a printout while doing so, and then "update the file" by some method of addressing the locations where the corrections were needed. The correction messages for this "batch" program were themselves perforated on paper tape and a computer correction or update program would search for the points where changes were required and substitute new information for old.

Such correction programs often involved addressing the stored text according to printout line numbers, or spaces within the line, although the input of line numbers, accompanied with matching strokes of characters, plus their corrections, were also sometimes used. If necessary, words such as "delete" or "substitute"—or mnemonics therefore—were employed, and occasionally the programs were clever enough to encompass commands to move paragraphs or other blocks of text from one location in the file to another.

Often such changes were made before the text was formatted for typesetting purposes, on the theory that no purpose would be served by going to the expense of running a computer composition or format program on faulty input, and incurring the additional expense of setting such text in type. On the other hand, even if pre-composition checking and correction did occur, not all errors could be detected, especially those errors pertaining to formatting problems—faulty command codes or codes which produced undesireable results which could not be foreseen. Almost invariably, then, it was necessary to correct and reprocess text which had already been through the "composition pass," whether it had gone on to the typesetter or had been represented again by means of some kind of printout.

Perplexing problems caused by inadequate solutions usually arose. Some composition programs did not produce output which was itself reprocessible. It was necessary to go back to the input file, where lines broke differently, if you could indeed locate the point at which changes were desired in such a file. Then you would have to go through the entire process all over again. In other cases two files were created: one which could be used to drive a typesetter and another which could be reprocessed but which otherwise resembled the output file. Or one file was sometimes output which could either be used to send to the typesetter (where certain kinds of information would be ignored) or back into the computer for correction (where commands required for the typesetting process would be disregarded).

Because computer files intended for typesetting were often very long it was usually necessary to reprocess them in their entirety. This was occasioned by the serial nature of such data. If one plunged into the middle of such a file to institute a change one might not know or be able to restore all relevant conditions. For example, a command might be inserted into the middle of a paragraph for the purpose of italicizing a word, but one might not think to go back out of italics into the pre-existing type face (if one knew what it was!) with the result that the remainder of the document would be set in italics, or even worse, 36 point bold display.

One thing that clearly emerged from this experimentation (and we must remember that by this time we were no longer in the laboratories but attempting to produce

commercially-viable products to a deadline) was that better correction procedures were clearly necessary and that they should if possible be interactive in nature, so that when changes were entered not only could one verify that they had been keyed correctly but also that one could determine immediately or reasonably soon thereafter what the effect of such changes would in fact be. In other words, there was a pressing need for a correction or update program which was *interactive* not only in the sense of implementing the changes, but in the broader sense of permitting the user to interact with the composition program itself.

The need for an on-line editorial system. At the same time that the commercial typesetting industry was struggling with the problem of how to transform words from a manuscript to paginated and typeset text pages, the newspaper industry was seeking to develop better solutions for handling wire service copy. Stories written by correspondents for these services (Associated Press and United Press International, for example) were being transmitted all over the country and indeed all over the world. While hard copy printouts were once considered sufficient, permitting local editors to pick up whatever they desired, modifying it by pen or pencil, and passing it on to the composing room for input into "the system," it was also possible to receive the same text in machine-readable form to be fed directly into a typesetter, or into a computer for composition formatting. However, most newspapers do not wish to print such stories intact, and the manner in which the stories were transmitted more or less assumed that some editing would take place, since corrections and "add-ons" were transmitted as separate takes. Hence the need for a way to review the stories on a video screen, to correct or modify them to suit local interests and editorial tastes, and then to transmit them through the system for typesetting. In the early 1970s such a terminal (the Harris 1500) was developed which accepted wire service input from paper tape and which enabled the editor to punch out an updated tape after he had made his changes.

Interestingly, that terminal was adopted by the commercial typesetting industry for the incorporation of changes in previously keyboarded local material even before it gained widespread acceptance in the area for which it had been intended.

Nevertheless, newspaper editorial systems were quick to develop. Initially they functioned in an environment in which reporters' stories were captured by OCR (optical character recognition) and then edited on video screens. Later, as union prohibitions were overcome and the economics of video terminal input were demonstrated, OCR gave way to direct VDT reporter input, and similar input of classified ads by the "telly ad takers."

The implications of an on-line editorial system. What made the transition occur so quickly, and in such a far-reaching manner, especially in the United States, was not just the advantage of avoiding the rekeyboarding of editorial (and classified) input. It was the *editorial control* which the system provided. A crude way of describing this was to use the term "the automation of the office boy." The all-electronic newsroom was to be a "paperless" environment, where all copy flow took place "through the system." While paper has not been entirely eliminated there is no question but that today the overwhelming proportion of editorial material appears in print without ever having been reproduced as hard copy. The process is quicker, easier, relatively trouble-free, and provides the managing editors with virtually total control of all of those processes which previously involved a

confused and tortuous relationship between writer, editor, proofreader and composing room.

Directories and cross directories. One of the features of newspaper editorial systems which makes them so powerful has been the development of file management programs especially conceived for these applications. Elaborate structures of various types have been created to facilitate the effective use of video terminals by people who are not only not familiar with computers but who would be hostile toward the use of any procedures which were not virtually transparent and trouble free and which did not provide instantaneous response. For example, the editor who "logs on" to his terminal may or may not have to provide a password, but once he is recognized (whether or not the terminal he is sitting at is "his") a certain level of security permitting him to access certain files and certain levels of files is immediately provided. He will be provided with his own "queue" or "queues" which may not be accessible to anyone else. Certain routing procedures are probably implied so that when he hits the "send" key the story he is working on will be automatically routed to his supervising editor, and when he hits the "next" key the next story destined for him will be brought onto the screen, according to a predefined sequence such as "LIFO," (last in, first out), or "FIFO", (first in, first out), or some arrangement which brings the "urgents" in ahead of any of the others. Not only will messages queued for his "in basket" be available for him when he logs on, but he may be reached with a message signal, or message line, at any time, with some messages made available even if he does not store his open story, and others waiting until he chooses to dispose of or store whatever it is that he is working on.

The reporter or editor can jump from one hierarchical sequence to another. If the "tree structure" approach is implemented he may be permitted to move up or down this structure, perhaps being confined to his "desk" (e.g., sports), or with read-only privileges to certain other desks (e.g., "national"), or for other queues or baskets for his edition of the paper, or other papers (such as the morning rather than the evening edition). He can call up directories, and specify whether he wants them "long" or "short" or of a certain length, in terms of the amount of the story beginning which will be displayed along with the tag lines. The directory will also have certain attributes so that, by means of cross directories he may be able to ask for a long or short directory of all sports stories which have been written or edited by a certain person, destined for a certain page of the newspaper, and already sent to the typesetting machine.

It is possible for there to be "edit trace" features which will reveal what changes have been made or suggested (either in terms of deletions or insertions) by the last person who opened that story, and it is also possible, in arranging procedures for copy flow, for every version or certain versions of the story to be spun off for archival purposes onto magnetic tape.

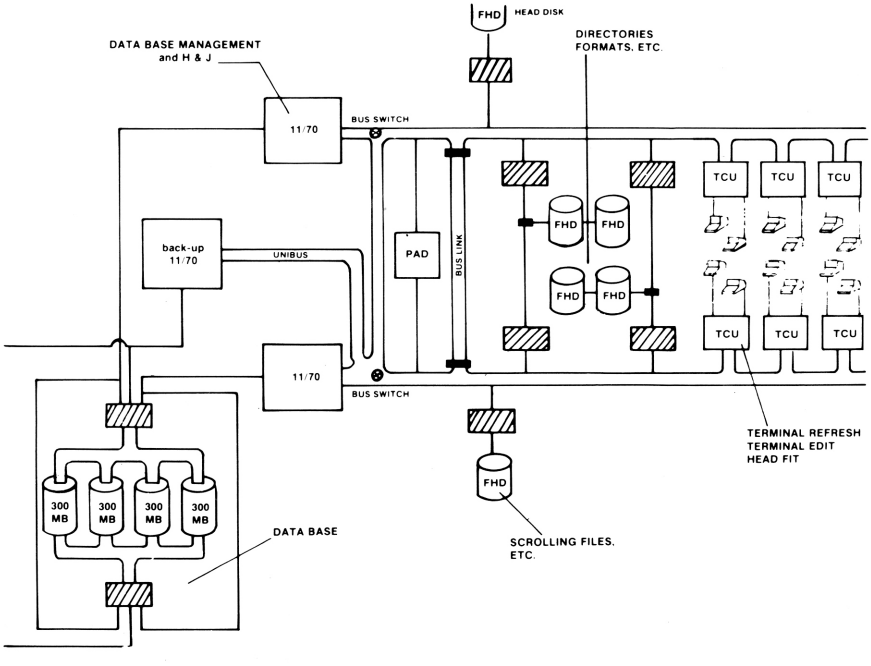
Demands upon the system. The implications to system architecture of these and other features are quite profound. First of all, in a newspaper environment, catastrophe strikes if a system goes down. Virtually all components must be redundant, including all files. In the second place, response times must be virtually instantaneous. One would expect to wait less than five seconds before a requested story from any place in the system could be accessed by a particular terminal. One would not want to wait more than ten or fifteen seconds at most for a

Left: Atex terminals at *Newsday* on Long Island have been used by writers and editors since 1975.

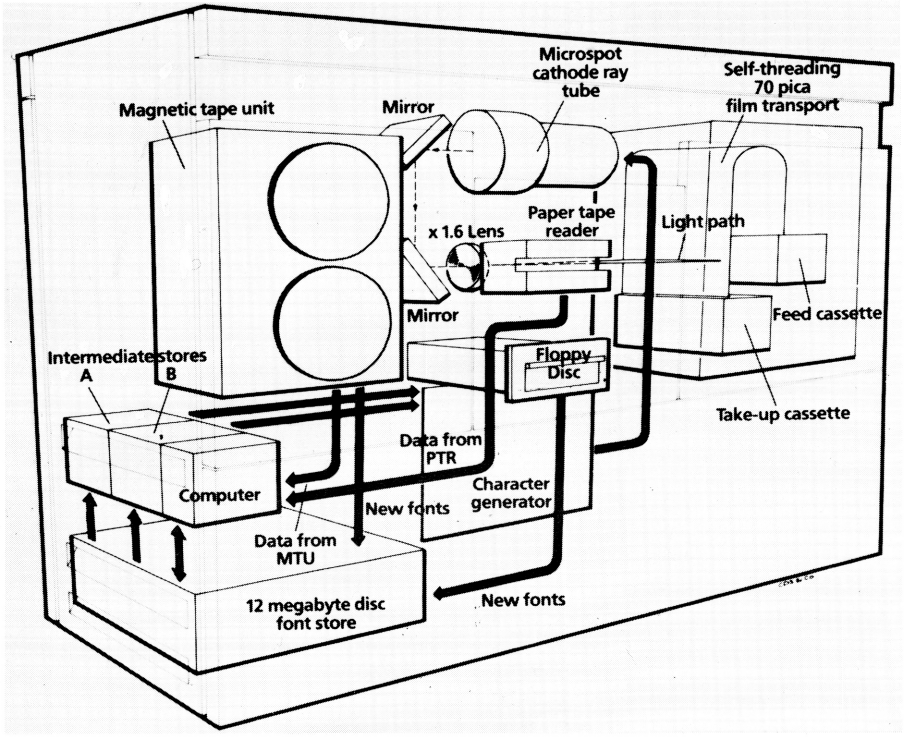
Right: A terminal from System Integrators displays a short directory—in this instance a listing of wire service stories, including slug name, ID number, source, date and time entered, and length. Stories can be called merely by positioning the cursor on the appropriate line.

DIRECTORY OF MORO (ALL) 5-10-78 11:44

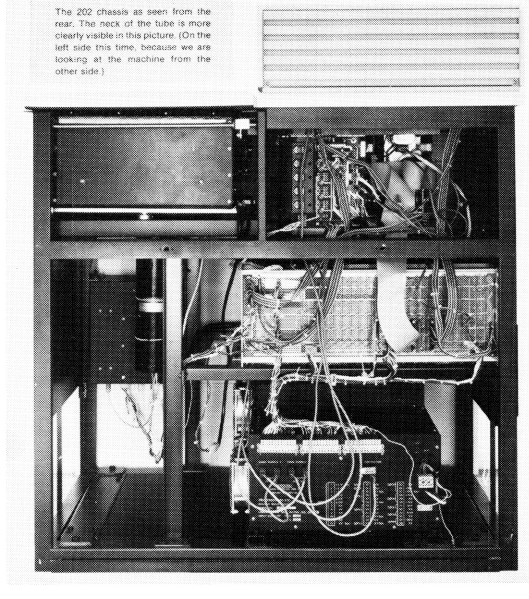
SLUG	G U I D E	AUTHOR	ENTERED	LENGTH
MORO	REDMONT RU 852	APA5828	5-10 11:36	33.98
MORO	$ LETTERS 1ST LD-WRITETH	APA5778	5-10 10:06	19.84
MORO	$ LETTERS BJT598 BY VICT	APA5688	5-10 9:35	18.17
MORO	642-48-1 W/K	APA5258	5-10 7:08	33.92
MORO	ROP 2ND LD-WRITETHRU A48	APA4948	5-10 4:13	34.97
MORO	ROP 1ST LD-WRITETHRU A45	APA4878	5-10 3:13	33.48
MORO	REACTION578 WITH MORO BJ	APA4858	5-10 2:57	15.43
MORO	ROP BJT1008 RETRANSMITTI	APA4688	5-10 1:42	29.75
MORO	FAMILY BJT498 BY HILMI T	APA4648	5-10 1:11	12.32
MORO	ROP BJT1008 LASERPHOTOS	APA4638	5-10 1:03	29.58



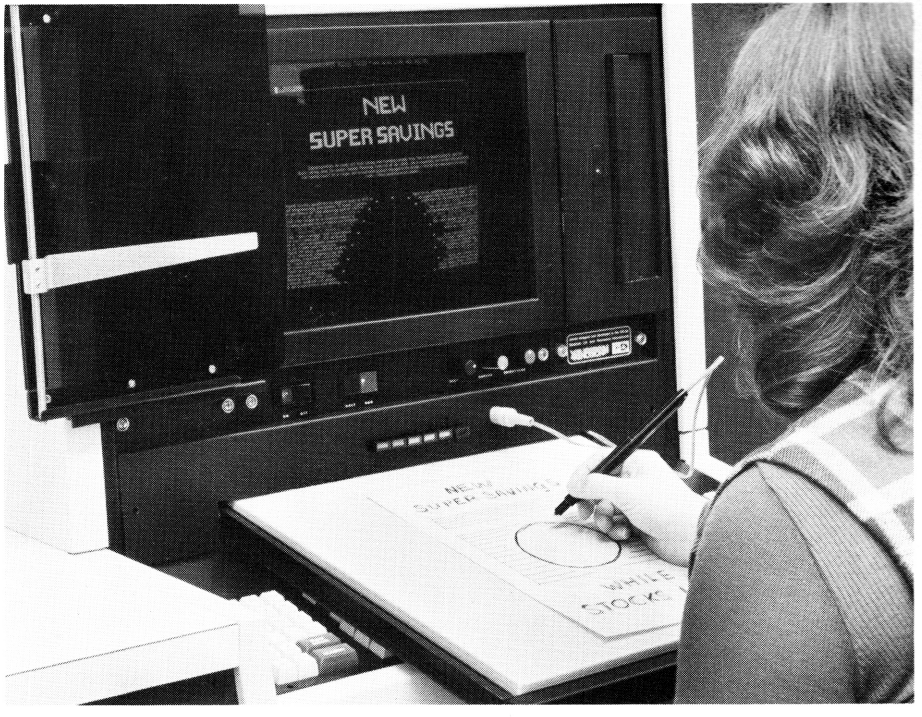
The Logicon TPS/6000 system, as it was installed at the Washington *Star,* illustrates a typical minicomputer configuration for newspaper editorial and classified use. Each TCU or terminal control unit supports editing and composition functions on a number of terminals, while the data base managers maintain all files in a form instantly accessible to users anywhere on the system. Note the back-up features and the four 300-MB disks.



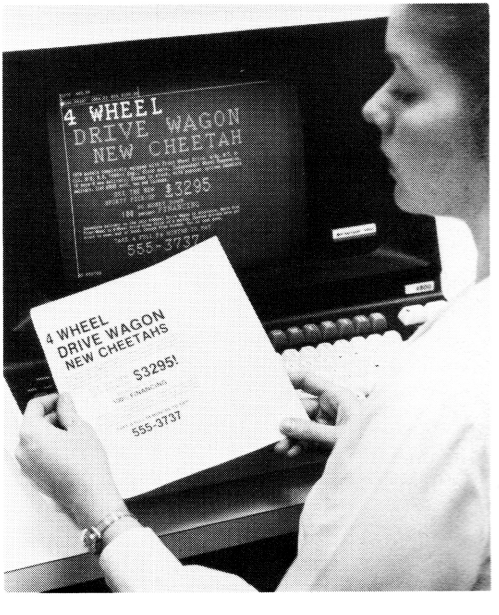
Above: The Mergenthaler Linotron 404 CRT typesetter design is similar to that of most of the third-generation photocomposition devices. The only mechanical element in the machine is the film transport mechanism which moves the photographic material across the CRT tube.


The 202 chassis as seen from the rear. The neck of the tube is more clearly visible in this picture. (On the left side this time, because we are looking at the machine from the other side.)

Right: The Linotron 202 is a very popular, low-cost third-generation cathode ray tube typesetter, widely used throughout the world, offering a wide variety of type faces on line, with setting speeds in the range of 600 lines per minute. This article has been composed on such a machine.



Above: Xenotron is a supplier of display ad composition work stations such as the Xenotron Video Composer shown here. Commands can be issued either from keyboard or tablet, and the stylus can also be used to indicate shapes and positions of text blocks. The screen display simulates the size and position of type to be generated by the final output device.



Right: Another similar display ad workstation is the AM 4800, which represents a current version of the original Harris 2200. Here the operator is holding typeset output of an ad designed on the 4800.

special directory, constructed by the use of cross directory functions, to come to the screen, and one would want to be able to get any story listed in that directory merely by placing the cursor on the listing and hitting a "fetch" key. And perhaps even more demanding upon the system is the response time expected for "h&j". For those editors charged with copy fitting responsibilities: if the editor makes changes and asks that the story be sent for composition formatting and brought back for his review, he would expect that not more than ten or fifteen seconds would elapse before he could bein to work on that story in its "hyphenated and justified" format. This means that the composition programs must be multi-threaded and/or re-entrant and possibly also that the system will route the story to whatever processor has the capacity at the moment. In addition, there are "copy fit" routines which provide even faster responses for copy depth estimates, and "head fit" routines which permit only the headlines to be counted for fitting, with an immediate report as to the extent to which the proposed wording is over or under the allotted width.

For classified ad takers, it is possible to send the ad to the system for copy fitting and to calculate the charge according to number of lines and other features while the placer is waiting on the phone. A credit check will also probably be run against the ad placer's phone number, and yet the ad taker will be expected to accept and to input, error-free, perhaps as many as 20 or 30 such ads per hour—or even more—during peak periods.

It is interesting to observe that the systems developed for the newspaper industry do not, generally speaking, consist of large main frame computers. Networks of minicomputers are generally used, and the operating systems have been especially designed to avoid irrelevant overhead demands.

To provide sufficient response time at the terminal level the architecture of the system tends to be of one of two varieties: the use of dual-ported memory plugged into a (Digital Equipment) PDP-11 unibus, or the use of intelligent terminals with a considerable amount of RAM with high-speed (e.g., 19,200 baud or better) data transfer from the host.

6. *Software For Composition*

Newspaper systems of the kind just described have been evolving for nearly twenty years, and especially since the mid 1970s when on-line video terminals began to be introduced in the United States for input and editing by journalists and for the taking of classified ads. The sophisticated features which such systems now offer presently go quite a distance beyond the capabilities available in the so-called "word processing" environment, and contain many features not necessary for "document processing" applications.

But not all typesetting systems in use today contain the same features as those required by newspapers, and while there is a great deal of commonality—even to the extent that some vendors can supply virtually the same hardware and software to newspaper and non-newspaper users—the requirements outside of the newspaper industry tend to place more emphasis upon batch processing, on the one hand, and highly-interactive processing on the other. It would seem probable that the batch processing approaches have more in common with those which we generally think of for purposes of "document processing."

A brief description of the evolution of systems for computerized composition may be helpful to provide some background for understanding where things stand at this particular juncture in the continuing evolution of text processing.

As we have already indicated, the first software for composition consisted of a single pass which read paper tape (which had been input in a "non-counting" mode without line-ending decisions) and formatted it for hot metal linecasting machines with TTS paper tape readers. This means that the program counted character widths and interword spaces in order to determine where to break the line in order to bring it within justification range, and also hyphenated "straddle" words where this was necessary in order to achieve justification.

In point of fact the program did not really "justify" lines but merely brought them within justification range; it was the linecasting machine's task to utilize its space band expansion capability to achieve the actual setting of justified text, presuming that all lines had indeed been broken within justification range.

Even the very early programs coped with the changing of fonts; a second font (bold or italic) was "duplexed" on the same linecaster matrices. Paper tape input contained "up the rail" and "downrail" command codes which would cause the typesetting device to activate a lever in order to position matrices in the alternative setting mode. In some cases character arrangements differed between the two fonts and translate tables were utilized to take this condition into account.

Since manual adjustments had to be made by the operator in order to permit the casting of each available point size, or to alter "body lead" (which determined the distance between lines) the initial programs were not concerned with the need to consider the effect of point size changes on the justification task during the processing of a given "take."

The next step was to develop the capability of "allocating" different outputs to machines with different set-ups, so that an input tape or a series of such tapes, could be analyzed by the processing program and computed according to the requirements of individual jobs and then routed to output devices already equipped with the desired magazines of type already mounted and the jaws set to the required measure. Thus the "torn tape" method evolved in newspaper applications, whereby the perforator operator ("keyboarder") would walk to the nearest of several paper tape readers, mount his tape to be accepted for input by the central processing unit on a polling basis, and a machine operator adjacent to a bank of linotype machines would tear from a cascading accumulation of computer-processed tape the most recent take, wind it onto a reel and mount it on the linecaster for which it was designated, reading the symbols on the tape leader for the necessary information to accomplish this.

When second-generation phototypesetters were introduced the torn-tape method of allocation was no longer necessary since now one machine offered the ability to set a variety of faces and sizes, even intermixing them within a given line. A program to drive such a typesetter thus became more complex since:

a.) the program had to cope with size changes
b.) it was necessary to take into account the different set width values of each font
c.) the arrangement of available characters or symbols might well differ from one font to another.

Moreover, some of these typesetting devices were driven as "slaves"—indeed, programmers preferred this condition—rather than in a manner in which the output device used its own internal logic to justify lines which the program merely brought within justification range.

If the computer program were permitted to accomplish precise justification it could then take more variables into account in the making of end-of-line decisions, or even in the implementation of decisions already made. Unlike their hot metal predecessors, photo-typesetting machines could usually handle spacing in fine increments, and could either add or take away hardly-discernible side bearing allowances between the escapement values of individual characters, in addition to "putting out" the customary variable interword spaces.

Other composition tasks. For photocomposition and even for hot metal setting, the task of composition involved more than the mere making of end-of-line decisions, including hyphenation. For example, individual lines, such as headings, could be set centered, or flush left or right, or "leadering" might be required. Ragged setting—left, right or center—might also be specified, or material might be justified but indented left, right or center, or with various combinations, such as indents within indents.

Some indents must "hang"—that is, the first line is not indented but the balance of the lines in the paragraph will be—or the value of the indent must be determined by the width of a combination of characters and spaces unknown to the input operator (a "variable" indent). The indent might be continued for a predetermined number of lines, or until some other command removes the condition.

All of these requirements seem trivial when one considers the task of inputting and composing tabular material, coping with a number of rows and columns of text, with some entries to be centered, or decimally-aligned within columns, and others to be justified, or even to be "run over" to succeeding rows within the same column. "Straddle heads" might be required to be centered optically over more than one column.

Correcting errors. Since photocomposing devices offer more opportunities for typographic flexibility, and to in order to achieve the varieties of setting which they made possible, it was clearly necessary to include more command codes within the text stream, and consequently the possibility of error multiplied accordingly. Mistakes are more readily made in typing illogical sequences of characters than in the typing of familiar words. But even for the preparation of relatively simple text the task of making corrections was considerably more complex than with the preparation of input for setting in hot metal.

With hot metal setting you had merely to remove and replace the offending characters or line slugs. With photocomposition output you had to cut and paste (or strip film) and to accomplish this so that the patched areas would not be discernible as such. Attention therefore focussed upon ways in which the final typeset output could be made perfect before it was set in type, and failing this, for the efficient incorporation of changes in the text prior to reprocessing.

The first correction program was introduced by Rocappi, a computer composition service bureau founded by this writer in the year 1963. This program was part of a "multiple-pass" system whose phases also accomplished galley composition and "pagination" (page make-up). Input (via paper tape) was read into the computer and stored on magnetic tape while a line-numbered printout was obtained. This printout could be proofread for typographic errors or for coding errors. A paper tape containing correction messages could then be prepared. These messages addressed the original text by line numbers and by interword spaces within the line. Programs of a similar nature were

developed by others, some of which located the errors within a given line by matching the string of characters which were in error:

20 teh, the

Words could be added or deleted in much the same manner. It was more difficult to transfer blocks of text.

The updated magnetic tape was then formatted (in Rocappi's Phase II) into justified lines, during the "h&j" (hyphenation and justification) pass. Again a printout was produced so that errors could be located and these would be more readily apparent since typesetting commands had now been acted upon and to some extent their consequences could be revealed on the printout. Words to be set in italic might be underlined (so that it was easier to detect the omission of the command to return again from italic to roman). Other font changes could be identified by overprints of assigned font numbers or some similar convention. The lines of text themselves, while not appearing to be justified on the printout, could nevertheless be inspected in order to review their line endings and the hyphenation solutions which the program had effected.

Subsequent passes in the Rocappi system provided for pagination of the line-justified output, and driver programs for a variety of phototypesetters. Ultimately many pre- and post-processors were added in order to cope with data base needs, such as the sorting and sequencing of "entries" of records, and the "explosion" of such records, as would be the case with parts and price lists, or catalogs and bibliographic materials.

Composition systems. By the mid 1960s the user had his choice of a number of programs or composition systems, most notably for the RCA 301, the IBM 1620, and the Digital Equipment PDP-8, as well as for the Honeywell 200. The 301 and the PDP-8 were particularly well suited for this more sophisticated application, involving printouts and correction procedures, since magnetic tape decks for these machines were relatively inexpensive and neither rigid nor floppy disks were then available or, if available, affordable within the context of a viable commercial operation.

Nevertheless there were significant differences in program conception and design. One important difference had to do with the manner in which the "h&j'd" output could be corrected. Some programs wrote out the composed output file directly in the language of the internal photocomposition device, with the consequence that this output was not reprocessible through the composition pass again. If changes were required (as determined by the reading of the h&j'd printout or of final, typeset galleys) it would be necessary to update the original input file, or a subsequent file which antedated the h&j'd version. As we have already suggested, this led to complications since it was difficult to locate the position in the input file which corresponded to the offending portion of the output. Three solutions emerged. One permitted the updating of the h&j'd version since the latter was maintained as a separate file in the computer's own internal language. The translation of this file to an output driver format became a separate operation and while the latter file could not be reprocessed, the former could be. Moreover, there was a real advantage in maintaining what proved to be a "generic", output-independent, version of the formatted text since typesetter driver programs could be developed more easily when such files constituted their input. These driver programs could be used to produce paper or magnetic tape in the format expected by a particular typesetting device, or, more commonly, came to be used to create spooling files from which a typesetter could be driven on line.

Shortcomings of the printout. It turns out, however, that a computer printout, even in upper and lower case, does not provide a satisfactory record for the proofreading of material to be photocomposed. The character repertoire of the customary line printer is too limited and there is no easy way to represent the many hundreds of special symbols and signs which typesetting machines have available and which readers of typeset products expect to see. While combinations of characters could be improvised to represent such symbols as the degree sign, the superior footnote call-out reference, the French accent circumflex or the Greek mu, even if the proofreader can cope with such conventions there is no assurance that the wanted characters will in fact appear and that the complex requirements of the job have been properly understood and executed.

Nor does the printout permit the proofreader to judge how successfully lines have been justified by the program unless spaceband statistics (indicating some measure of looseness or relative tightness) are also provided.

Consequently commercial typesetters found it useful to "go to type" several times so that they could proofread and correct galleys—if not pages—in a form similar to that contemplated for the final product. Because of the cost of the necessary photographic materials "soft typesetters" were developed by some vendors. This provided the capability of reviewing the formatted material on a video screen in a manner which simulated the appearance of the type itself. Obviously this required the use of video displays which could represent generic versions of such type faces as serif and sans serif, bold, roman and italic, in sizes and with character widths which were as precise as possible. Unfortunately such "soft typesetters" were generally not interactive devices. In other words, while you could see the probable results on the screen, you generally had to go back to a monospaced version in order to make changes.

7. Batch Versus "Interactive"

Batch processing of text proved to be tedious and extravagant in many cases. In the early days of such efforts, such as with the RCA PAGE-1 program which was introduced in the late 1960s, an entire book might have had to be reprocessed many times, even through to the typesetting device. Keyboarding mistakes (both "typos" and the more serious errors in input and correctness of composition commands) simply could not be avoided by the most tedious efforts at "quality control" and every time new changes were introduced it was necessary to go back to the beginning to reformat the entire document, re-running it through hyphenation and justification, as well as pagination and typesetting. The only solution available was to do the job in many small "takes" and try, somehow, to merge them together. For the most part pagination was abandoned as too difficult to achieve. Galley composition was more congenial since individual galleys could be recomposed as often as necessary, and hand make-up (paste-up) was resorted to for page assembly. Even today (1982) pagination is not common among commercial typesetters except for very straight-forward materials. In any event, batch solutions are too risky and expensive for most of the tasks the typical typesetter is called upon to cope with. There is simply too much reprocessing of long files.

One way out has been provided by the capability of "partial processing" of text through the hyphenation and justification routine. A company by the name of *Imlac,* now a

subsidiary of Hazeltine, offered such a capability in the early 1970s. It is possible for the user to re-start the h&j process at any point in the text, but as the program was originally written he was obliged to continue the process from that point on to the conclusion of the "take." Imlac also pioneered in offering a display of proportionally-spaced characters in several sizes on the screen, thus simulating, to some degree, the appearance of "true type."

Another company, *Atex, Inc.*, took the concept of partial processing one step further by enabling the user to define any text block, at the video terminal level, and to process or reprocess only that block through h&j, making whatever changes in parameters were desired in order to avoid a "widow" (a paragraph ending with a single word on a line by itself) or a "hanger" (a paragraph ending with only a portion of a word by itself), or to achieve better interword spacing or meet copyfitting requirements. In the same fashion, other corrections could be introduced without affecting the balance of the job.

Due to the serial nature of formatting commands, previously alluded to, there is always the risk that some variable introduced when working with a single block of text might inadvertently be carried forward. Atex's use of "style files" helps to avoid this problem. Eight modes can be represented on the screen and each mode can stand for different stylistic conditions, having to do not only with type face and point size parameters, but line length, leading, hyphenation characteristics, justified or ragged setting and other such conditions. The style file is literally a separate file which is referenced when the composition pass is run. Style files can therefore be redefined at will without the need to access the document itself.

Unless there are specific overriding parameters embedded in the text, the mode definitions obtain for all processing runs and for instructions to the output typesetting device.

But even these "interactive" solutions are not sufficient for some requirements. The most highly interactive of all composition programs is offered by stand-alone systems or subsystems for the setting of display ads. These terminals or systems permit the user to associate with any block or element of text any parameters he desires. The text file is brought in to terminal memory, often without any markup whatever except for some indication of block endings. A block could be as short as a single stand-alone line such as "Spring Sale!" Or it might consist of a brief descriptive paragraph pertaining, for example, to the features of the product. The user has the opportunity, however, to split predefined blocks apart, or to combine them into one, or, having arranged them as he wishes, subsequently to freeze the relationships between the elements so that they can treated as a unit—as, for instance, moving them about the page. Moreover, subsequent strings of text which are to be formatted in the same manner can automatically be assigned the same characteristics and thus spring into position and format.

While the operator may be required to type in a few commands relating to selection of type face, all other features can be assigned by approximation. By striking an "enlarge" key the operator can cause the block to be composed in the next available larger point size, and likewise a "reduce" key will step down to successively smaller point sizes. Up and down arrows can cause the block of text to be moved in a vertical dimension within the defined ad space, and other arrows will float the text to desired horizontal locations.

While the first of these devices (the Harris 2200) was entirely keyboard-controlled, subsequent vendors provide for the use of a graphic tablet not only to indicate the desired

position of text elements but also to "pick" commands, or to sketch boundaries and outlines within which text might be "flowed." This feature was first introduced by *Camex* and is now also available on products by *Raytheon, Compugraphic, Xenotron, Mycro-Tek* and *Linotype-Paul.*

While it would appear that these same techniques would be helpful for the composition of text matter other than display ads, limitations in software and hardware design inhibited the general use of such solutions. They have been successfully applied to tabular composition and to the production of business forms, but only within the last year has there been any evidence that they might be extended to applications involving the processing of substantial areas of running text, as opposed to small blocks, records or entries each of which can be readily identified and assigned its unique properties.

Real Time Composition Systems. The Bedford Computer Company, under the leadership of its founder, N. Edward Berg, managed to combine some of the features of the display ad terminal with those of more conventional text processing, in what is called the Real Time Composition System, although the name could also be used to describe a generic classification of such systems as they emerge in imitation of the Berg concept.

Features of the Berg system include the ability to show on the screen of the video terminal a simulation of "true" type styles, in different sizes and with the actual width values of the characters in the desired fonts. This is done by means of bit-map display technology, but other kinds of screen display techniques might also be applied.

The ability to define text elements for manipulation according to assigned attributes, and to see the results immediately is also a characteristic of this approach. Each defined element is able to "stand on its own" and the text may be re-arranged, as in the Atex approach, without losing its identity. Thus blocks of type can be treated much as they were in the hot metal days, when they could be picked up physically and moved about within a form—excepting that now, of course, the attributes can easily be redefined at any time.

8. When Is Batch Better?

Now that we have begun to explore the possibilities of interactive composition—a process which can be aided by the use of such exciting tools as bit-map displays, even, perhaps, the use of color monitors—graphic tablets, and software which permit on-line manipulation, we come to appreciate, however, that some tasks are handled more efficiently in a batch environment. Preference for the use of interactive solutions for the correction or modification of those proposed by batch methods has been made evident for many classes of work. This is especially true for the pagination of documents. Here interactive intervention may only be required in order to deal with certain recalcitrant situations, such as the positioning of text and graphics in mutually-beneficial juxtaposition.

On the other hand, there are many situations in which interaction is essential—even, or perhaps especially, an editorial environment. A classic example is the news magazine, in which stories are written to fit pre-assigned spaces. A similar example is the mail order catalog where copy is also carefully allocated. In such cases either the original author or the copy editor must have recourse to hyphenation and justification and he is permitted not only to change the parameters (within limits) to achieve the desired result, but also to

modify the text itself for this purpose. Not even a "copy depth estimate" program, which counts characters but does not compute line endings, is sufficient for the precise fitting of text.

While some feel that interactivity is necessary for aesthetic reasons, to permit the operator to make subtle changes in relationships between particular characters or text blocks, others argue that it is indeed possible to de-skill many matters of aesthetic judgment, as may be witnessed by the extensive use of kerning tables which have been developed by type experts for individual fonts and which can be applied automatically even when the users are not aware of what the niceties of kerning imply.

9. Varieties of Pagination Approaches

Although there was a great deal of interest in pagination programs in the 1960s, when attention focused on automating the production operations of trade composition shops setcorprimarily engaged in "book work," the primary interest in the 1970s lay in newspaper editorial systems, and, to a lesser degree, similar systems for news magazines. Newspapers were not particularly interested in page make-up programs. Display ads had to be pasted up in any event, and there was an abundance of labor in the composing room production operation due to the fact of "keystroke capture" in editorial offices—at least in the United States and Canada where union restrictions gave way to the imperative of technological advance.

Today, however, concern over the adequacy of pagination solutions is receiving a great deal more attention for several reasons. First, because it now seems possible to output graphics as well as type, thus removing one element that would have had to be stripped-in in any event. Second, because new technology is pointing toward the possibility of going "direct-to-plate"—which would make paste-up impossible. Third, because an increasing volume of newspapers and magazines are being printed in more than one location, and this tends to encourage the transmission of "complete" and "perfect" pages (including graphics). Fourth, perhaps because of the prospect of a growth in "demand printing," since delivery to the home, office or library of paginated documents tailored to the needs of the individual reader could conceivably revolutionize the delivery of the printed word.

It is clear, at least to this writer, that there is no universal solution to the problems of page make-up. Paging systems are often an essential part of the editorial process and under such circumstances cannot be left entirely to non-interactive approaches. In some instances pagination is in fact a by-product of the editorial control and management of copyflow, and this should properly be the case with newspapers and many magazines.

It is unfortunate that some of those who are concerned with document preparation have a myopic view of the aesthetic and creative aspects of publishing, tending to think only of ways to get the manuscript out the door and into the hands of the reading public. The present excitement about "word processing" encourages—at least momentarily—the exacerbation of the tendency to apply simplistic solutions to the arrangement of text and graphics on a page. However, it is to be anticipated that interest will continue to grow in "going to type" from document- and word-processing systems. Many trade typesetters are making quite a business of accepting word processing input, usually via telecommunications, and also magnetic tapes supplied from main-frame document processing systems.

In some instances the output is galleys which are then pasted up as pages by supplier or customer. In other cases straight-forward pages are handled in a manner not much different from the pagination routines of word processing programs: the generation of "headers" and "footers" with fairly arbitrary page break procedures, often permitting "widows" at the top of pages, frequently not observing consistent page depth specifications, and failing to cope with footnotes, or positioning them badly.

10. Document Processing, Word Processing and Typesetting

The presentations in this book, with the exception of the contribution by this writer, whose background and experience differs significantly from most of his colleagues in this common venture, will no doubt support the conclusion that increasingly sophisticated batch solutions are becoming available and may prove to be advantageous especially in situations in which most documents conform to pre-determined specifications. Generic coding introduced by the user provides most of the information required for purposes of composition.

On the other hand, it is to be expected that input and editing terminals with bit map or similar displays capable of representing type images and areas for interactive manipulation will certainly become more practical in the future and the quality of electrographic bit-map or raster-scan output devices will be successfully combined even at the microprocessor level, so that "what you see" will be "what you get."

A final observation must also be made. Many existing document processing systems seem to this writer to be extravagant in terms of their use of computer resources and personnel. This may be tolerated and possibly encouraged in a scientific or academic environment. But the applications which emerge from this area—perhaps including some described in this book—even if they meet the aesthetic requirements of "commercial typesetting"—may not offer solutions which are practical in an economic sense. On the other hand, those developed for commercial use may also prove to be viable in a scholarly setting. Such an example is offered by the adoption by the Supreme Court of the United States of an Atex copy processing system with all of the features Atex has developed for its newspaper and national publishing accounts. Atex is of course not alone among the vendors and developers of sophisticated but "dedicated" commercial copy processing systems. The question arises as to whether such systems can become more "general-purpose" in nature without compromising their efficiency in their field of primary application and, conversely, whether more general-purpose configurations can be taught, over time, to offer many of the advantages inherent in the better dedicated systems.